

10/573130

IAP20 Rec'd PCT/PTO 23 MAR 2006

SEQUENCE LISTING

<110> Sturmer, Rainer
Kesseler, Maria
Hauer, Bernhard
Friedrich, Thomas
Breuer, Michael

<120> Methods for the production of
3-methylamino-1-(thiene-2-yl)-propane-1-ol

<130> 13111-00035-US

<150> PCT/EP2004/010939
<151> 2004-09-30

<150> DE 103 45 772.0
<151> 2003-10-01

<160> 44

<170> PatentIn version 3.3

<210> 1

<211> 47

<212> PRT

<213> Lactobacillus brevis

<400> 1

Met Ser Asn Arg Leu Asp Gly Lys Val Ala Ile Val Thr Gly Gly Thr
1 5 10 15

Leu Gly Ile Gly Leu Ala Ile Ala Thr Lys Phe Val Glu Glu Gly Ala
20 25 30

Lys Val Met Ile Thr Gly Arg His Ser Asp Val Gly Glu Lys Ala
35 40 45

<210> 2
<211> 18
<212> PRT
<213> Candida magnoliae

<400> 2

Ser Asn Ala Leu Val Thr Gly Gly Ser Arg Val Ile Gly Ala Gly Gly
1 5 10 15

Phe Ile

<210> 3

<211> 756

<212> DNA

<213> Lactobacillus brevis

<220>

<221> CDS

<222> (1)..(756)

<400> 3

atg tct aac cgt ttg gat gga aaa gta gca atc gtt aca ggt ggt acg	48
Met Ser Asn Arg Leu Asp Gly Lys Val Ala Ile Val Thr Gly Gly Thr	
1 5 10 15	

ttg ggt atc ggt tta gct atc gcc acg aag ttc gtt gaa gaa ggg gct	96
Leu Gly Ile Gly Leu Ala Ile Ala Thr Lys Phe Val Glu Glu Gly Ala	
20 25 30	

aag gtc atg att acc ggc cg ^g cac agc gat gtt ggt gaa aaa gca gct	144
Lys Val Met Ile Thr Gly Arg His Ser Asp Val Gly Glu Lys Ala Ala	
35 40 45	

aag agt gtc ggc act cct gat cag att caa ttt ttc caa cat gat tct	192
Lys Ser Val Gly Thr Pro Asp Gln Ile Gln Phe Phe Gln His Asp Ser	
50 55 60	

tcc gat gaa gac ggc tgg acg aaa tta ttc gat gca acg gaa aaa gcc	240
Ser Asp Glu Asp Gly Trp Thr Lys Leu Phe Asp Ala Thr Glu Lys Ala	
65 70 75 80	

ttt ggc cca gtt tct aca tta gtt aat aac gct ggg atc gcg gtt aac	288
Phe Gly Pro Val Ser Thr Leu Val Asn Asn Ala Gly Ile Ala Val Asn	
85 90 95	

aag agt gtc gaa gaa acc acg act gct gaa tgg cgt aaa cta tta gcc	336
Lys Ser Val Glu Glu Thr Thr Ala Glu Trp Arg Lys Leu Leu Ala	
100 105 110	

gtc aac ctt gat ggt gtc ttc ggt acc cga tta ggg att caa cgg	384
Val Asn Leu Asp Gly Val Phe Phe Gly Thr Arg Leu Gly Ile Gln Arg	
115 120 125	

atg aag aac aaa ggc tta ggg gct tcc atc atc aac atg tct tcg atc	432
Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile	
130 135 140	

gaa ggc ttt gtg ggt gat cct agc tta ggg gct tac aac gca tct aaa	480
---	-----

Glu	Gly	Phe	Val	Gly	Asp	Pro	Ser	Leu	Gly	Ala	Tyr	Asn	Ala	Ser	Lys	
145															160	
ggg	gcc	gta	cgg	att	atg	tcc	aag	tca	gct	gcc	tta	gat	tgt	gcc	cta	528
Gly	Ala	Val	Arg	Ile	Met	Ser	Lys	Ser	Ala	Ala	Leu	Asp	Cys	Ala	Leu	
165														175		
aag	gac	tac	gat	gtt	cgg	gta	aac	act	gtt	cac	cct	ggc	tac	atc	aag	576
Lys	Asp	Tyr	Asp	Val	Arg	Val	Asn	Thr	Val	His	Pro	Gly	Tyr	Ile	Lys	
180														190		
aca	cca	ttg	gtt	gat	gac	cta	cca	ggg	gcc	gaa	gaa	gcg	atg	tca	caa	624
Thr	Pro	Leu	Val	Asp	Asp	Leu	Pro	Gly	Ala	Glu	Glu	Ala	Met	Ser	Gln	
195														205		
cg	acc	aag	acg	cca	atg	ggc	cat	atc	ggt	gaa	cct	aac	gat	att	gcc	672
Arg	Thr	Lys	Thr	Pro	Met	Gly	His	Ile	Gly	Glu	Pro	Asn	Asp	Ile	Ala	
210														220		
tac	atc	tgt	gtt	tac	ttg	gct	tct	aac	gaa	tct	aaa	ttt	gca	acg	ggt	720
Tyr	Ile	Cys	Val	Tyr	Leu	Ala	Ser	Asn	Glu	Ser	Lys	Phe	Ala	Thr	Gly	
225														235	240	
tct	gaa	ttt	gta	gtt	gac	ggt	ggc	tac	act	gct	caa				756	
Ser	Glu	Phe	Val	Val	Asp	Gly	Gly	Tyr	Thr	Ala	Gln					
245														250		

<210> 4

<211> 252

<212> PRT

<213> Lactobacillus brevis

<400> 4

Met	Ser	Asn	Arg	Leu	Asp	Gly	Lys	Val	Ala	Ile	Val	Thr	Gly	Gly	Thr
1														15	

Leu	Gly	Ile	Gly	Leu	Ala	Ile	Ala	Thr	Lys	Phe	Val	Glu	Glu	Gly	Ala
20														30	

Lys	Val	Met	Ile	Thr	Gly	Arg	His	Ser	Asp	Val	Gly	Glu	Lys	Ala	Ala
35														45	

Lys	Ser	Val	Gly	Thr	Pro	Asp	Gln	Ile	Gln	Phe	Phe	Gln	His	Asp	Ser
50														60	

Ser	Asp	Glu	Asp	Gly	Trp	Thr	Lys	Leu	Phe	Asp	Ala	Thr	Glu	Lys	Ala
65														80	

Phe	Gly	Pro	Val	Ser	Thr	Leu	Val	Asn	Ala	Gly	Ile	Ala	Val	Asn	
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--

85

90

95

Lys Ser Val Glu Glu Thr Thr Ala Glu Trp Arg Lys Leu Leu Ala
 100 105 110

Val Asn Leu Asp Gly Val Phe Phe Gly Thr Arg Leu Gly Ile Gln Arg
 115 120 125

Met Lys Asn Lys Gly Leu Gly Ala Ser Ile Ile Asn Met Ser Ser Ile
 130 135 140

Glu Gly Phe Val Gly Asp Pro Ser Leu Gly Ala Tyr Asn Ala Ser Lys
 145 150 155 160

Gly Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Asp Cys Ala Leu
 165 170 175

Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly Tyr Ile Lys
 180 185 190

Thr Pro Leu Val Asp Asp Leu Pro Gly Ala Glu Glu Ala Met Ser Gln
 195 200 205

Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro Asn Asp Ile Ala
 210 215 220

Tyr Ile Cys Val Tyr Leu Ala Ser Asn Glu Ser Lys Phe Ala Thr Gly
 225 230 235 240

Ser Glu Phe Val Val Asp Gly Gly Tyr Thr Ala Gln
 245 250

<210> 5

<211> 472

<212> DNA

<213> Candida magnoliae

<220>

<221> CDS

<222> (1)...(471)

<400> 5

aac	gct	ctg	gtg	acg	ggc	ggc	agc	cgc	ggc	att	ggc	gaa	gcc	act	gcc		48
Asn	Ala	Leu	Val	Thr	Gly	Gly	Ser	Arg	Gly	Ile	Gly	Glu	Ala	Thr	Ala		
1		5								10				15			
att	aag	ctc	gcc	gag	gag	ggc	tac	agc	gtc	acg	att	gct	tct	cgc	ggc		96
Ile	Lys	Leu	Ala	Glu	Glu	Gly	Tyr	Ser	Val	Thr	Ile	Ala	Ser	Arg	Gly		
		20								25				30			
ctt	aag	cag	ctc	gag	gct	gtg	aag	gcc	aaa	cta	ccc	att	gtg	aag	cag		144
Leu	Lys	Gln	Leu	Glu	Ala	Val	Lys	Ala	Lys	Leu	Pro	Ile	Val	Lys	Gln		
		35								40				45			
gga	cag	gtt	cac	cac	gtg	tgg	cag	ctt	gat	ctc	agt	gat	gtc	gac	gct		192
Gly	Gln	Val	His	His	Val	Trp	Gln	Leu	Asp	Leu	Ser	Asp	Val	Asp	Ala		
		50								55				60			
gct	gcc	gcc	tcc	aaa	ggg	tgc	ccg	cta	cct	gcc	agc	cgc	tac	gac	gtg		240
Ala	Ala	Ala	Phe	Lys	Gly	Ser	Pro	Leu	Pro	Ala	Ser	Arg	Tyr	Asp	Val		
		65								70				75			80
ctc	gtc	agc	aat	gct	ggc	gtg	gcc	cag	ttt	agc	ccg	ttc	atc	gag	cat		288
Leu	Val	Ser	Asn	Ala	Gly	Val	Ala	Gln	Phe	Ser	Pro	Phe	Ile	Glu	His		
		85								90				95			
gct	aag	cag	gac	tgg	tgc	cag	atg	ctt	gcc	atc	aat	ctg	gct	gca	ccc		336
Ala	Lys	Gln	Asp	Trp	Ser	Gln	Met	Leu	Ala	Ile	Asn	Leu	Ala	Ala	Pro		
		100								105				110			
att	gct	gtc	gcc	cag	aca	ttt	gct	aag	gcc	att	ggc	gac	aag	ccg	cgc		384
Ile	Ala	Leu	Ala	Gln	Thr	Phe	Ala	Lys	Ala	Ile	Gly	Asp	Lys	Pro	Arg		
		115								120				125			
aac	aca	ccg	gcc	cac	att	gtg	ttt	gtc	tgc	tgc	aac	gtc	tcg	ttg	cga		432
Asn	Thr	Pro	Ala	His	Ile	Val	Phe	Val	Ser	Ser	Asn	Val	Ser	Leu	Arg		
		130								135				140			
ggc	ttc	ccg	aac	atc	ggc	gtc	aac	tcc	atc	acc	ccc	ggc	a			472	
Gly	Phe	Pro	Asn	Ile	Gly	Val	Asn	Ser	Ile	Thr	Pro	Gly					
		145								150				155			

<210> 6

<211> 157

<212> PRT

<213> Candida magnoliae

<400> 6

Asn	Ala	Leu	Val	Thr	Gly	Gly	Ser	Arg	Gly	Ile	Gly	Glu	Ala	Thr	Ala	
1					5					10				15		

Ile	Lys	Leu	Ala	Glu	Glu	Gly	Tyr	Ser	Val	Thr	Ile	Ala	Ser	Arg	Gly	
										20				30		

Leu Lys Gln Leu Glu Ala Val Lys Ala Lys Leu Pro Ile Val Lys Gln
 35 40 45

Gly Gln Val His His Val Trp Gln Leu Asp Leu Ser Asp Val Asp Ala
 50 55 60

Ala Ala Ala Phe Lys Gly Ser Pro Leu Pro Ala Ser Arg Tyr Asp Val
 65 70 75 80

Leu Val Ser Asn Ala Gly Val Ala Gln Phe Ser Pro Phe Ile Glu His
 85 90 95

Ala Lys Gln Asp Trp Ser Gln Met Leu Ala Ile Asn Leu Ala Ala Pro
 100 105 110

Ile Ala Leu Ala Gln Thr Phe Ala Lys Ala Ile Gly Asp Lys Pro Arg
 115 120 125

Asn Thr Pro Ala His Ile Val Phe Val Ser Ser Asn Val Ser Leu Arg
 130 135 140

Gly Phe Pro Asn Ile Gly Val Asn Ser Ile Thr Pro Gly
 145 150 155

<210> 7
<211> 27
<212> DNA
<213> Artificial sequence

<220>
<223> Primer: Mke 338

<400> 7
gggaattcca tatgtctaac cgtttgg

27

<210> 8
<211> 28
<212> DNA
<213> Artificial sequence

<220>
<223> Primer: Mke 339

<400> 8
cgttaggaaag cttattgagc agtgttagc

28

<210> 9
<211> 28
<212> DNA

<213> Artificial sequence
<220>
<223> Primer: Mke 366
<400> 9
acgacgacga gcaacgcbct bgtbacgg

28

<210> 10
<211> 28
<212> DNA
<213> Artificial sequence
<220>
<223> Primer: Mke 367
<400> 10
acgacgacgt cgaacgcbct bgtbacgg

28

<210> 11
<211> 27
<212> DNA
<213> Artificial sequence
<220>
<223> Primer: Mke 374
<400> 11
gccggggttg atsswgttsa cgccgat

27

<210> 12
<211> 10
<212> PRT
<213> Lactobacillus brevis

<220>
<221> MISC_FEATURE
<222> (1)..(10)
<223> Fragment: C terminus

<400> 12
Phe Val Val Asp Gly Gly Tyr Thr Ala Gln
1 5 10

<210> 13
<211> 18
<212> PRT
<213> Candida magnoliae

<220>
<221> VARIANT
<222> (1)..(1)
<223> Amino acid is Ser, Gly or Thr

<220>
<221> VARIANT
<222> (2)..(2)
<223> Amino acid is Thr or Pro

<400> 13

Ser Thr Thr Ser Asn Ala Leu Val Thr Gly Gly Ser Arg Gly Ile Gly
1 5 10 15

Ala Ala

<210> 14
<211> 9
<212> PRT
<213> Candida magnoliae

<400> 14

Ile Gly Val Asn Ser Ile Asn Pro Gly
1 5

<210> 15
<211> 60
<212> PRT
<213> Lactobacillus brevis

<220>
<221> VARIANT
<222> (47)..(47)
<223> Amino acid is Ala or Lys

<220>
<221> UNSURE
<222> (48)..(48)
<223> Amino acid is Lys or Ala

<220>
<221> VARIANT
<222> (53)..(53)
<223> Amino acid is Pro or Thr

<220>
<221> VARIANT
<222> (59)..(59)
<223> Amino acid is Phe, Val, Gly, or Asn

<220>
<221> misc_feature
<222> (60)..(60)
<223> Xaa is unreadable

<400> 15

Ser Asn Arg Leu Asp Gly Lys Val Ala Ile Val Thr Gly Gly Thr Leu
 1 5 10 15

Gly Ile Gly Leu Ala Ile Ala Thr Lys Phe Val Glu Glu Gly Ala Lys
 20 25 30

Val Met Ile Thr Gly Arg His Ser Asp Val Gly Glu Lys Ala Ala Lys
 35 40 45

Ser Val Gly Thr Pro Asp Gln Ile Gln Phe Phe Xaa
 50 55 60

<210> 16

<211> 20

<212> PRT

<213> Lactobacillus brevis

<220>

<221> VARIANT

<222> (1)..(1)

<223> Amino acid is Thr, Ser, or Phe

<220>

<221> VARIANT

<222> (2)..(2)

<223> Amino acid is Pro, Val, or Ala

<220>

<221> VARIANT

<222> (3)..(3)

<223> Amino acid is Leu, Gly, or Thr

<220>

<221> VARIANT

<222> (4)..(4)

<223> Amino acid is Val or Thr

<220>

<221> VARIANT

<222> (5)..(5)

<223> Amino acid is Asp, Pro, or Ser

<220>

<221> VARIANT

<222> (6)..(6)

<223> Amino acid is Asp, Glu, or Ile

<220>

<221> VARIANT

<222> (7)..(7)

<223> Amino acid is Leu, Gln, Phe, or Ala

<220>

<221> VARIANT

<222> (8)..(8)

```

<223> Amino acid is Pro, Ile, or Val

<220>
<221> VARIANT
<222> (9)..(9)
<223> Amino acid is Gly, Gln, Lys, or Pro

<220>
<221> VARIANT
<222> (10)..(10)
<223> Amino acid is Ala or Phe

<220>
<221> VARIANT
<222> (11)..(11)
<223> Amino acid is Glu or Phe

<220>
<221> VARIANT
<222> (12)..(12)
<223> Amino acid is Glu or Gln

<220>
<221> VARIANT
<222> (13)..(13)
<223> Amino acid is Ala, His, or Tyr

<220>
<221> VARIANT
<222> (14)..(14)
<223> Amino acid is Met, Asp, or Thr

<220>
<221> VARIANT
<222> (15)..(15)
<223> Amino acid is Ser or Arg

<220>
<221> UNSURE
<222> (18)..(18)

<220>
<221> misc_feature
<222> (19)..(20)
<223> Xaa is unreadable

<400> 16

Thr Pro Leu Val Asp Asp Leu Pro Gly Ala Glu Glu Ala Met Ser Gln
1 5 10 15

Arg Arg Xaa Xaa
20

<210> 17
<211> 15
<212> PRT
<213> Lactobacillus brevis

```

<220>
 <221> UNSURE
 <222> (10)..(10)

<220>
 <221> misc_feature
 <222> (12)..(15)
 <223> Xaa is unreadable

<400> 17

Ser Val Glu Glu Thr Thr Thr Ala Glu Trp Arg Xaa Xaa Xaa Xaa
 1 5 10 15

<210> 18
 <211> 20
 <212> PRT
 <213> Lactobacillus brevis

<220>
 <221> misc_feature
 <222> (8)..(8)
 <223> Xaa is J

<400> 18

Ser Val Gly Thr Pro Asp Gln Xaa Gln Phe Phe Gln His Asp Ser Ser
 1 5 10 15

Asp Glu Asp Gly
 20

<210> 19
 <211> 15
 <212> PRT
 <213> Lactobacillus brevis

<220>
 <221> VARIANT
 <222> (1)..(1)
 <223> Amino acid is Val or Leu

<220>
 <221> VARIANT
 <222> (2)..(2)
 <223> Amino acid is Asn or Phe

<220>
 <221> VARIANT
 <222> (3)..(3)
 <223> Amino acid is Thr or Asp

<220>

<221> VARIANT
 <222> (4)..(4)
 <223> Amino acid is Val or Ala

<220>
 <221> VARIANT
 <222> (5)..(5)
 <223> Amino acid is His or Thr

<220>
 <221> VARIANT
 <222> (6)..(6)
 <223> Amino acid is Pro or Glu

<220>
 <221> VARIANT
 <222> (7)..(7)
 <223> Amino acid is Gly or Lys

<220>
 <221> VARIANT
 <222> (8)..(8)
 <223> Amino acid is Tyr or unreadable

<220>
 <221> VARIANT
 <222> (9)..(9)
 <223> Amino acid is J or unreadable

<220>
 <221> VARIANT
 <222> (10)..(10)
 <223> Amino acid is Lys or unreadable

<220>
 <221> misc_feature
 <222> (11)..(15)
 <223> Xaa is unreadable

<400> 19

Val	Asn	Thr	Val	His	Pro	Gly	Tyr	Xaa	Lys	Xaa	Xaa	Xaa	Xaa
1					5				10				15

<210> 20
 <211> 4
 <212> PRT
 <213> Lactobacillus brevis

<220>
 <221> VARIANT
 <222> (1)..(1)
 <223> Amino acid is Val or Leu

<220>
 <221> VARIANT
 <222> (2)..(2)
 <223> Amino acid is Asn or Phe

<220>
<221> VARIANT
<222> (3)..(3)
<223> Amino acid is Thr or Asp

<220>
<221> VARIANT
<222> (4)..(4)
<223> Amino acid is Val or Ala

<400> 20

Val Asn Thr Val

1

<210> 21
<211> 7
<212> PRT
<213> Lactobacillus brevis

<220>
<221> VARIANT
<222> (1)..(1)
<223> Amino acid is Ala, Val, Ile, Leu or Ser

<220>
<221> VARIANT
<222> (2)..(2)
<223> Amino acid is Phe or Met

<220>
<221> VARIANT
<222> (4)..(4)
<223> Amino acid is Pro or Gln

<220>
<221> VARIANT
<222> (5)..(5)
<223> Amino acid is Gly or Tyr

<220>
<221> VARIANT
<222> (7)..(7)
<223> Amino acid is Arg or Asn

<400> 21

Ala Phe Ile Pro Gly Lys Arg
1 5

<210> 22
<211> 15
<212> PRT
<213> Lactobacillus brevis

<220>
<221> UNSURE
<222> (1)...(1)

<220>
<221> misc_feature
<222> (6)...(6)
<223> Xaa is unreadable

<220>
<221> misc_feature
<222> (10)...(15)
<223> Xaa is unreadable

<400> 22

Ser Ala Ala Leu Asp Xaa Ala Leu Lys Xaa Xaa Xaa Xaa Xaa Xaa
1 5 10 15

<210> 23
<211> 18
<212> PRT
<213> Lactobacillus brevis

<220>
<221> VARIANT
<222> (1)...(1)
<223> Amino acid is Ser or Phe

<220>
<221> VARIANT
<222> (2)...(2)
<223> Amino acid is Ala or unsure

<220>
<221> VARIANT
<222> (3)...(3)
<223> Amino acid is Ala or Thr

<220>
<221> VARIANT
<222> (4)...(4)
<223> Amino acid is Leu or Gly

<220>
<221> VARIANT
<222> (5)...(5)
<223> Amino acid is Asp or Ser

<220>
<221> VARIANT
<222> (6)...(6)
<223> Amino acid is unreadable or Glu

<220>
<221> VARIANT
<222> (7)...(7)
<223> Amino acid is Ala or Phe

<220>
<221> VARIANT
<222> (8)..(8)
<223> Amino acid is Leu or Val

<220>
<221> VARIANT
<222> (9)..(9)
<223> Amino acid is Lys or Val

<220>
<221> VARIANT
<222> (10)..(10)
<223> Amino acid is Asp or unsure

<220>
<221> VARIANT
<222> (11)..(11)
<223> Amino acid is Tyr or Gly

<220>
<221> VARIANT
<222> (12)..(12)
<223> Amino acid is unreadable or Gly

<220>
<221> VARIANT
<222> (13)..(13)
<223> Amino acid is Val or Tyr

<220>
<221> VARIANT
<222> (14)..(14)
<223> Amino acid is Arg or Thr

<220>
<221> VARIANT
<222> (15)..(15)
<223> Amino acid is unreadable or Ala

<220>
<221> VARIANT
<222> (16)..(16)
<223> Amino acid is unreadable or Gln

<220>
<221> misc_feature
<222> (17)..(18)
<223> Xaa is unreadable

<400> 23

Ser Ala Ala Leu Asp Xaa Ala Leu Lys Asp Tyr Xaa Val Arg Xaa Xaa
1 5 10 15

Xaa Xaa

<210> 24
<211> 17
<212> PRT
<213> Lactobacillus brevis

<220>
<221> misc_feature
<222> (6)..(6)
<223> Xaa is unreadable

<220>
<221> misc_feature
<222> (10)..(17)
<223> Xaa is unreadable

<400> 24

Ser	Ala	Ala	Leu	Asp	Xaa	Ala	Leu	Lys	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa
1					5				10					15

Xaa

<210> 25
<211> 20
<212> PRT
<213> Lactobacillus brevis

<220>
<221> misc_feature
<222> (16)..(20)
<223> Xaa is unreadable

<400> 25

Lys	Leu	Leu	Ala	Val	Asn	Leu	Asp	Gly	Val	Phe	Phe	Gly	Thr	Arg	Xaa
1						5				10				15	

Xaa Xaa Xaa Xaa
20

<210> 26
<211> 6
<212> PRT
<213> Lactobacillus brevis

<220>
<221> misc_feature
<222> (1)..(1)
<223> Xaa is unreadable

<220>

<221> misc_feature
<222> (3)..(3)
<223> Xaa is unreadable

<400> 26

Xaa Met Xaa Thr Gly Arg
1 5

<210> 27
<211> 15
<212> PRT
<213> Lactobacillus brevis

<220>
<221> VARIANT
<222> (1)..(1)
<223> Amino acid is Thr, Ser, or Phe

<220>
<221> VARIANT
<222> (2)..(2)
<223> Amino acid is Lys or Ala

<220>
<221> VARIANT
<222> (3)..(3)
<223> Amino acid is Thr or Ala

<220>
<221> VARIANT
<222> (4)..(4)
<223> Amino acid is Phe, Leu, or Gly

<220>
<221> VARIANT
<222> (5)..(5)
<223> Amino acid is Met, Asp, or Ser

<220>
<221> VARIANT
<222> (6)..(6)
<223> Amino acid is Gly or Glu

<220>
<221> VARIANT
<222> (7)..(7)
<223> Amino acid is His, Ala, or Phe

<220>
<221> VARIANT
<222> (8)..(8)
<223> Amino acid is Ile, Leu, or Val

<220>
<221> VARIANT
<222> (9)..(9)
<223> Amino acid is unreadable, Lys, or Val

```

<220>
<221> VARIANT
<222> (10)..(10)
<223> Amino acid is Glu or Asp

<220>
<221> VARIANT
<222> (11)..(11)
<223> Amino acid is Pro, Tyr, or Gly

<220>
<221> VARIANT
<222> (12)..(12)
<223> Amino acid is Asn, Asp, or Gly

<220>
<221> VARIANT
<222> (13)..(13)
<223> Amino acid is unreadable, Val, or Tyr

<220>
<221> VARIANT
<222> (14)..(14)
<223> Amino acid is Ile, Arg, or Thr

<220>
<221> VARIANT
<222> (15)..(15)
<223> Amino acid is Ala or unreadable

<400> 27

```

Thr	Lys	Thr	Pro	Met	Gly	His	Ile	Xaa	Glu	Pro	Asn	Xaa	Ile	Ala
1					5				10				15	

```

<210> 28
<211> 20
<212> PRT
<213> Lactobacillus brevis

```

```

<220>
<221> VARIANT
<222> (1)..(1)
<223> Amino acid is Thr, Phe, or Ser

<220>
<221> VARIANT
<222> (2)..(2)
<223> Amino acid is Lys or Ala

<220>
<221> VARIANT
<222> (3)..(3)
<223> Amino acid is Thr or Ala

<220>
<221> VARIANT

```

<222> (4)..(4)
<223> Amino acid is Pro, Gly, or Leu

<220>
<221> VARIANT
<222> (5)..(5)
<223> Amino acid is Met, Ser, or Asp

<220>
<221> VARIANT
<222> (6)..(6)
<223> Amino acid is Gly, Glu, or Cys (unsure)

<220>
<221> VARIANT
<222> (7)..(7)
<223> Amino acid is unknown, Phe, or Ala

<220>
<221> VARIANT
<222> (8)..(8)
<223> Amino acid is Ile, Val, or Leu

<220>
<221> VARIANT
<222> (9)..(9)
<223> Amino acid is Ala (unsure), Val, or Lys

<220>
<221> VARIANT
<222> (10)..(10)
<223> Amino acid is Glu or Asp

<220>
<221> VARIANT
<222> (11)..(11)
<223> Amino acid is Pro (unsure), Gly, or Tyr

<220>
<221> VARIANT
<222> (12)..(12)
<223> Amino acid is Asn (unsure), Gly, or Asp

<220>
<221> VARIANT
<222> (13)..(13)
<223> Amino acid is Asp (unsure), Tyr, or Val

<220>
<221> VARIANT
<222> (14)..(14)
<223> Amino acid is Ile, Thr, or Arg

<220>
<221> VARIANT
<222> (15)..(15)
<223> Amino acid is Ala or unreadable

<220>
<221> VARIANT

<222> (16)..(16)
<223> Amino acid is Tyr or Gln

<220>
<221> misc_feature
<222> (17)..(20)
<223> Xaa is unreadable

<400> 28

Thr Lys Thr Pro Met Gly Xaa Ile Ala Glu Pro Asn Asp Ile Ala Tyr
1 5 10 15

Xaa Xaa Xaa Xaa
20

<210> 29
<211> 25
<212> PRT
<213> Lactobacillus brevis

<220>
<221> VARIANT
<222> (1)..(1)
<223> Amino acid is Lys, Thr, or Gln

<220>
<221> VARIANT
<222> (2)..(2)
<223> Amino acid is Ala or Gly

<220>
<221> VARIANT
<222> (3)..(3)
<223> Amino acid is Ala or Leu

<220>
<221> VARIANT
<222> (4)..(4)
<223> Amino acid is Lys or Phe

<220>
<221> VARIANT
<222> (5)..(5)
<223> Amino acid is Ser, Leu, or Arg

<220>
<221> VARIANT
<222> (7)..(7)
<223> Amino acid is Gly or Val

<220>
<221> VARIANT
<222> (8)..(8)
<223> Amino acid is Thr, Leu, or Val

<220>

```
<221> VARIANT
<222> (9)..(9)
<223> Amino acid is Pro or Arg

<220>
<221> VARIANT
<222> (10)..(10)
<223> Amino acid is Asp, Val, or Asn

<220>
<221> VARIANT
<222> (11)..(11)
<223> Amino acid is Gln, Ala, or Glu

<220>
<221> VARIANT
<222> (12)..(12)
<223> Amino acid is Ile or Thr

<220>
<221> VARIANT
<222> (13)..(13)
<223> Amino acid is Gln or Val

<220>
<221> VARIANT
<222> (15)..(15)
<223> Amino acid is Phe or Pro

<220>
<221> VARIANT
<222> (16)..(16)
<223> Amino acid is Gln or Gly

<220>
<221> VARIANT
<222> (17)..(17)
<223> Amino acid is His or Tyr

<220>
<221> VARIANT
<222> (18)..(18)
<223> Amino acid is Asp or Ile

<220>
<221> VARIANT
<222> (19)..(19)
<223> Amino acid is Ser, Lys, or Asp

<220>
<221> VARIANT
<222> (20)..(20)
<223> Amino acid is Ser or Ala

<220>
<221> VARIANT
<222> (21)..(21)
<223> Amino acid is Phe or Thr

<220>
```

<221> VARIANT
 <222> (23)..(23)
 <223> Amino acid is Val (unsure) or Ala

<220>
 <221> VARIANT
 <222> (24)..(24)
 <223> Amino acid is Val (unsure) or Asn

<220>
 <221> UNSURE
 <222> (25)..(25)

<400> 29

Lys	Ala	Ala	Lys	Ser	Val	Gly	Thr	Pro	Asp	Gln	Ile	Gln	Phe	Phe	Gln
1				5						10			15		

His	Asp	Ser	Ser	Pro	Glu	Val	Val	Gln
		20				25		

<210> 30
 <211> 20
 <212> PRT
 <213> Lactobacillus brevis

<220>
 <221> misc_feature
 <222> (1)..(1)
 <223> Xaa is unreadable

<220>
 <221> VARIANT
 <222> (2)..(2)
 <223> Amino acid is Val, Lys, or Arg

<220>
 <221> VARIANT
 <222> (5)..(5)
 <223> Amino acid is Leu or Ala

<220>
 <221> VARIANT
 <222> (10)..(10)
 <223> Amino acid is unreadable, Ile, or Asp

<220>
 <221> misc_feature
 <222> (11)..(20)
 <223> Xaa is unreadable

<400> 30

Xaa	Val	Lys	Leu	Leu	Ala	Val	Asn	Leu	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa
1					5				10			15		

Xaa Xaa Xaa Xaa

20

<210> 31
<211> 20
<212> PRT
<213> Lactobacillus brevis

<220>
<221> VARIANT
<222> (1)..(1)
<223> Amino acid is Thr, Gly, or Val

<220>
<221> VARIANT
<222> (3)..(3)
<223> Amino acid is Phe or Val

<220>
<221> VARIANT
<222> (4)..(4)
<223> Amino acid is Phe or Asn

<220>
<221> VARIANT
<222> (5)..(5)
<223> Amino acid is Gly (unsure) or Thr

<220>
<221> VARIANT
<222> (6)..(6)
<223> Amino acid is Leu or Val

<220>
<221> VARIANT
<222> (7)..(7)
<223> Amino acid is Lys or His

<220>
<221> VARIANT
<222> (8)..(8)
<223> Amino acid is Gln or Pro

<220>
<221> VARIANT
<222> (9)..(9)
<223> Amino acid is Asn or Gly

<220>
<221> VARIANT
<222> (10)..(10)
<223> Amino acid is Ile or Tyr

<220>
<221> VARIANT
<222> (11)..(11)
<223> Amino acid is Glu or Ile

<220>
<221> VARIANT
<222> (12)..(12)
<223> Amino acid is Asn, Lys, or Asp

<220>
<221> VARIANT
<222> (13)..(13)
<223> Amino acid is Ile or Thr

<220>
<221> VARIANT
<222> (14)..(14)
<223> Amino acid is Asn or Pro

<220>
<221> VARIANT
<222> (15)..(15)
<223> Amino acid is Ile, Asn, or Leu

<220>
<221> VARIANT
<222> (16)..(16)
<223> Amino acid is Ala, Met, Gly, or Val

<220>
<221> VARIANT
<222> (17)..(17)
<223> Amino acid is Ala or Asp

<220>
<221> VARIANT
<222> (18)..(18)
<223> Amino acid is Val or Asp

<220>
<221> VARIANT
<222> (19)..(19)
<223> Amino acid is Arg, Asp, or Leu

<220>
<221> Unsure
<222> (20)..(20)

<400> 31

Thr Val Phe Phe Gly Leu Lys Gln Asn Ile Glu Asn Ile Asn Ile Ala
1 5 10 15

Ala Val Arg Pro
20

<210> 32
<211> 30
<212> PRT
<213> Lactobacillus brevis

<220>
<221> VARIANT
<222> (1)..(1)
<223> Amino acid is Gly, Gln, Thr, or Pro

<220>
<221> VARIANT
<222> (2)..(2)
<223> Amino acid is Phe, Val, or Ser

<220>
<221> VARIANT
<222> (3)..(3)
<223> Amino acid is Val or Leu

<220>
<221> VARIANT
<222> (5)..(5)
<223> Amino acid is Asp, Ala, or Ile

<220>
<221> VARIANT
<222> (6)..(6)
<223> Amino acid is Pro, Gln, or Tyr

<220>
<221> VARIANT
<222> (7)..(7)
<223> Amino acid is Ser, Asn, Arg, or Lys

<220>
<221> VARIANT
<222> (8)..(8)
<223> Amino acid is Leu, Met, or Ala

<220>
<221> VARIANT
<222> (9)..(9)
<223> Amino acid is Gly or Lys

<220>
<221> VARIANT
<222> (10)..(10)
<223> Amino acid is Ala, Asn, or Lys

<220>
<221> VARIANT
<222> (11)..(11)
<223> Amino acid is Tyr, Gly, or Lys

<220>
<221> VARIANT
<222> (12)..(12)
<223> Amino acid is Asn, Gly, or Ala

<220>
<221> VARIANT
<222> (13)..(13)
<223> Amino acid is Ala, Leu, or Val

<220>
 <221> VARIANT
 <222> (14)..(14)
 <223> Amino acid is Gly, Ser, or Arg

<220>
 <221> VARIANT
 <222> (15)..(15)
 <223> Amino acid is Lys, Ala, or Ile

<220>
 <221> VARIANT
 <222> (16)..(16)
 <223> Amino acid is Gly, Met, or Ser

<220>
 <221> VARIANT
 <222> (17)..(17)
 <223> Amino acid is Ala or Ile

<220>
 <221> VARIANT
 <222> (18)..(18)
 <223> Amino acid is Val or Lys

<220>
 <221> VARIANT
 <222> (19)..(19)
 <223> Amino acid is Arg or Asn

<220>
 <221> VARIANT
 <222> (20)..(20)
 <223> Amino acid is Ile, Met, or Ala

<220>
 <221> UNSURE
 <222> (28)..(28)

<220>
 <221> misc_feature
 <222> (29)..(30)
 <223> Xaa is unreadable

<400> 32

Gly Phe Val Gly Asp Pro Ser Leu Gly Ala Tyr Asn Ala Gly Lys Gly
 1 5 10 15

Ala Val Arg Ile Met Ser Lys Ser Ala Ala Leu Asp Xaa Xaa
 20 25 30

<210> 33
 <211> 10
 <212> PRT
 <213> Lactobacillus brevis

<220>
<221> misc_feature
<222> (5)..(10)
<223> Xaa is unreadable

<400> 33

Phe Val Val Asp Xaa Xaa Xaa Xaa Xaa Xaa
1 5 10

<210> 34
<211> 20
<212> PRT
<213> Lactobacillus brevis

<220>
<221> VARIANT
<222> (1)..(1)
<223> Amino acid is Asp or Arg

<220>
<221> VARIANT
<222> (2)..(2)
<223> Amino acid is Gly, Lys, or Tyr

<220>
<221> VARIANT
<222> (3)..(3)
<223> Amino acid is unreadable, Leu (unsure), or Phe (unsure)

<220>
<221> VARIANT
<222> (4)..(4)
<223> Amino acid is Thr or Lys

<220>
<221> VARIANT
<222> (5)..(5)
<223> Amino acid is Lys, Asp, or Pro

<220>
<221> VARIANT
<222> (6)..(6)
<223> Amino acid is Leu or Ala

<220>
<221> VARIANT
<222> (8)..(8)
<223> Amino acid is Asp or Glu

<220>
<221> VARIANT
<222> (9)..(9)
<223> Amino acid is Ala or Asp

<220>
<221> UNSURE
<222> (12)..(12)

<220>
<221> misc_feature
<222> (13)..(20)
<223> Xaa is unreadable

<400> 34

Asp Gly Xaa Thr Lys Leu Phe Asp Ala Thr Glu Glu Xaa Xaa Xaa Xaa
1 5 10 15

Xaa Xaa Xaa Xaa
20

<210> 35
<211> 14
<212> PRT
<213> Lactobacillus brevis

<220>
<221> misc_feature
<222> (11)..(14)
<223> Xaa is unreadable

<400> 35

Phe Val Val Asp Gly Gly Tyr Thr Ala Gln Xaa Xaa Xaa Xaa
1 5 10

<210> 36
<211> 30
<212> PRT
<213> Lactobacillus brevis

<220>
<221> misc_feature
<222> (1)..(1)
<223> Xaa is unreadable

<220>
<221> VARIANT
<222> (2)..(2)
<223> Amino acid is Ala or Ser

<220>
<221> VARIANT
<222> (24)..(24)
<223> Amino acid is Val (unsure) or Asp

<220>
<221> VARIANT
<222> (30)..(30)
<223> Amino acid is Glu or Gly (unsure)

<400> 36

Xaa Ala Leu Lys Asp Tyr Asp Val Arg Val Asn Thr Val His Pro Gly
 1 5 10 15

Tyr Ile Lys Thr Pro Leu Val Val Asp Leu Pro Gly Ala Glu
 20 25 30

<210> 37
 <211> 15
 <212> PRT
 <213> Lactobacillus brevis

<400> 37

Lys Ala Ala Lys Ser Val Gly Thr Pro Asp Gln Ile Gln Phe Phe
 1 5 10 15

<210> 38
 <211> 13
 <212> PRT
 <213> Lactobacillus brevis

<400> 38

Gly Ala Lys Val Met Ile Thr Gly Arg His Ser Asp Val
 1 5 10

<210> 39
 <211> 10
 <212> PRT
 <213> Lactobacillus brevis

<220>
 <221> VARIANT
 <222> (1)..(1)
 <223> Amino acid is Ser or Ala

<220>
 <221> VARIANT
 <222> (3)..(3)
 <223> Amino acid is Phe or Gly

<220>
 <221> VARIANT
 <222> (5)..(5)
 <223> Amino acid is Thr, Phe, or Ile

<220>
 <221> VARIANT
 <222> (6)..(6)
 <223> Amino acid is Gly or Val

<220>
 <221> VARIANT
 <222> (7)..(7)

<223> Amino acid is Ser or Tyr

<220>

<221> VARIANT

<222> (8)..(8)

<223> Amino acid is Glu or Leu

<400> 39

Ser Lys Phe Ala Thr Gly Ser Glu Phe Val
1 5 10

<210> 40

<211> 25

<212> PRT

<213> Lactobacillus brevis

<220>

<221> misc_feature

<222> (1)..(1)

<223> Xaa is unreadable

<220>

<221> VARIANT

<222> (2)..(2)

<223> Amino acid is Asp, Val, Ser, or Leu

<220>

<221> VARIANT

<222> (3)..(3)

<223> Amino acid is Val, Phe, or Leu

<220>

<221> VARIANT

<222> (4)..(4)

<223> Amino acid is Arg, Lys, or Gly

<220>

<221> VARIANT

<222> (5)..(5)

<223> Amino acid is Val, Ile, Ala, or Gly

<220>

<221> VARIANT

<222> (14)..(14)

<223> Amino acid is Lys or Gly

<220>

<221> VARIANT

<222> (15)..(15)

<223> Amino acid is Thr or Ala

<220>

<221> VARIANT

<222> (19)..(19)

<223> Amino acid is Asp or Asn

<220>

<221> VARIANT
 <222> (20)..(20)
 <223> Amino acid is Asp or Met

<220>
 <221> VARIANT
 <222> (22)..(22)
 <223> Amino acid is Pro or Leu

<400> 40

Xaa	Asp	Val	Arg	Val	Asn	Thr	Val	His	Pro	Gly	Tyr	Ile	Lys	Thr	Pro
1															
					5				10					15	

Leu	Val	Asp	Asp	Leu	Pro	Gly	Ala	Glu
		20			25			

<210> 41
 <211> 40
 <212> PRT
 <213> Lactobacillus brevis

<220>
 <221> misc_feature
 <222> (2)..(2)
 <223> Xaa is unreadable

<220>
 <221> UNSURE
 <222> (36)..(38)

<220>
 <221> misc_feature
 <222> (39)..(40)
 <223> Xaa is unreadable

<400> 41

Trp	Xaa	Lys	Leu	Leu	Ala	Val	Asn	Leu	Asp	Gly	Val	Phe	Phe	Gly	Thr
1															
									5		10			15	

Arg	Leu	Gly	Ile	Gln	Arg	Met	Lys	Asn	Lys	Gly	Leu	Gly	Ala	Ser	Ile
			20					25					30		

Ile	Asn	Met	Ser	Ser	Ile	Xaa	Xaa
		35			40		

<210> 42
 <211> 40
 <212> PRT
 <213> Lactobacillus brevis

<220>

<221> UNSURE
<222> (1)..(1)

<220>
<221> VARIANT
<222> (3)..(3)
<223> Amino acid is Ser, Lys, or Ala

<220>
<221> VARIANT
<222> (4)..(4)
<223> Amino acid is Gln, Leu, Lys, or Glu

<220>
<221> VARIANT
<222> (5)..(5)
<223> Amino acid is Arg, Leu, or Ser

<220>
<221> VARIANT
<222> (6)..(6)
<223> Amino acid is Thr, Ala, or Val

<220>
<221> VARIANT
<222> (7)..(7)
<223> Amino acid is Lys, Val, or Gly

<220>
<221> VARIANT
<222> (8)..(8)
<223> Amino acid is Thr or Asn

<220>
<221> VARIANT
<222> (9)..(9)
<223> Amino acid is Pro or Leu

<220>
<221> VARIANT
<222> (10)..(10)
<223> Amino acid is Met, Asp, or Ala

<220>
<221> VARIANT
<222> (11)..(11)
<223> Amino acid is Gly, Gln, or Tyr

<220>
<221> VARIANT
<222> (12)..(12)
<223> Amino acid is His, Val, Ile, or Asn

<220>
<221> VARIANT
<222> (13)..(13)
<223> Amino acid is Ile, Phe, Ala, or Gln

<220>
<221> VARIANT

<222> (14)..(14)
 <223> Amino acid is Gly (unsure) or Phe

<220>
 <221> VARIANT
 <222> (15)..(15)
 <223> Amino acid is Glu or Gly

<220>
 <221> VARIANT
 <222> (16)..(16)
 <223> Amino acid is Pro or Thr

<220>
 <221> VARIANT
 <222> (17)..(17)
 <223> Amino acid is Asn or Arg

<220>
 <221> VARIANT
 <222> (18)..(18)
 <223> Amino acid is Asp or Leu

<220>
 <221> VARIANT
 <222> (19)..(19)
 <223> Amino acid is Ile or Gly

<220>
 <221> VARIANT
 <222> (20)..(20)
 <223> Amino acid is Ala or Ile

<220>
 <221> VARIANT
 <222> (21)..(21)
 <223> Amino acid is Tyr or Gln

<220>
 <221> VARIANT
 <222> (25)..(25)
 <223> Amino acid is Tyr or Asn

<220>
 <221> VARIANT
 <222> (27)..(27)
 <223> Amino acid is Ala or Gly

<220>
 <221> misc_feature
 <222> (37)..(39)
 <223> Xaa is unknown

<400> 42

Ala Met Ser Gln Arg Thr Lys Thr Pro Met Gly His Ile Gly Glu Pro
 1 5 10 15.

Asn Asp Ile Ala Tyr Arg Met Lys Tyr Lys Ala Leu Gly Ala Ser Ile

20

25

30

Ile Asn Met Ser Xaa Xaa Xaa Gly
 35 40

<210> 43
 <211> 15
 <212> PRT
 <213> Lactobacillus brevis

<220>
 <221> misc_feature
 <222> (12)..(15)
 <223> Xaa is unreadable

<400> 43

Ser Lys Phe Ala Thr Gly Ser Glu Phe Val Val Xaa Xaa Xaa Xaa
 1 5 10 15

<210> 44
 <211> 15
 <212> PRT
 <213> Lactobacillus brevis

<220>
 <221> VARIANT
 <222> (1)..(1)
 <223> Amino acid is Ser, Ala, Phe, or Val

<220>
 <221> VARIANT
 <222> (4)..(4)
 <223> Amino acid is Ala or Thr

<220>
 <221> VARIANT
 <222> (5)..(5)
 <223> Amino acid is Thr, Ile, or Pro

<220>
 <221> VARIANT
 <222> (6)..(6)
 <223> Amino acid is Gly, Leu, or Asp

<220>
 <221> VARIANT
 <222> (7)..(7)
 <223> Amino acid is Ser or Gln

<220>
 <221> VARIANT
 <222> (8)..(8)
 <223> Amino acid is Glu or Ile

<220>
<221> VARIANT
<222> (9)..(9)
<223> Amino acid is Phe or Gln

<220>
<221> VARIANT
<222> (11)..(11)
<223> Amino acid is Val, Leu, or Ser

<220>
<221> VARIANT
<222> (12)..(12)
<223> Amino acid is Asp, Gln, or Lys

<220>
<221> misc_feature
<222> (13)..(15)
<223> Xaa is unreadable

<400> 44

Ser Lys Phe Ala Thr Gly Ser Glu Phe Val Val Asp Xaa Xaa Xaa
1 5 10 15